1,136,166

PATENT SPECIFICATION 1,136,166

DRAWINGS ATTACHED.

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COMPLETE SPECIFICATION.

Ball and Process for Production Thereof.

We, HOLLEY PLASTICS COMPANY, a Corporation organised under the laws of the State of Michigan, one of the United States of America, and having a place of business at 8655e Eight-Mile Road, Warren, Michigan, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to balls and more specifically, but not exclusively, is concerned with the manufacture of golf balls having predetermined properties.

In the past golf balls have usually been constructed by wrapping thin bands of rubber about a spherical core and subsequently encasing the core and rubber wrappings in a spherical shell of plastics material. Such manufacture requires a plurality of separate individual steps and complicated machinery. The manufacturing of golf balls has therefore in the past been time consuming and expensive.

In addition it has been difficult with prior manufacturing processes and materials to produce golf balls which are perfectly round and which have the requisite rebound, click and color. Further, prior balls have not been particularly rugged and may be easily cut if not hit squarely, which cutting immediately produces an out-of-round condition in the cut ball.

According to the present invention, there is provided a process for manufacturing a ball which comprises mixing one hundred parts by weight of a urethane prepolymer with from three to twelve parts by weight of a curing agent for the urethane prepolymer, placing the resultant mixture in an empty mold having a shape corresponding to that of the desired ball and curing the mixture to obtain the required ball.

Advantageously, the process of the present invention includes the steps of heating the urethane prepolymer and the curing agent before mixing the same together. If the curing is effected at room temperature, this may be accomplished in approximately three weeks. Alternatively, the curing may be accomplished more rapidly by heating the mixture in the mold, removing the partially cured mixture from the mold and subsequently completing the curing by further heating out of the mold. In this way more balls can be produced from the mold per unit time.

If desired, the mixture may include up to one part by wt of a catalyst such as adipic acid, up to one hundred (preferably up to fifty) parts by weight of a plasticiser such as 2-ethyl hexyl diglycolate, up to one hundred parts by weight of a colorant and/or filler, up to two parts by weight of an ultraviolet light absorber and/or up to ten parts by weight of an internal lubricant. Further, the mixture may include glass or powdered resins, minerals or metals.

A particularly preferred urethane prepolymer is an isocyanate terminated prepolymer containing from 4.0 to 4.3% isocyanate groups by weight. The curing agent may be, for example, 3.3'-dichlorobenzidine, 4,4-methylene-bis-(2-chloroaniline), or metaphenylene diamine.

Both the urethane prepolymer and the curing agent together with their additives may be degassed. This can be accomplished with vacuum degassers which are commer-

cially available. Without degassing the urethane prepolymers which are susceptible to moisture may not react sufficiently to provide a golf ball with the desired properties. Processing of materials for production type operations can be accomplished with commercial machines that heat, mix, meter and dispense the mixture on demand. The degassing operation can also be included in the processing steps.

For a better understanding of the invention and to show how the same may be carried into effect, reference will be made, by way of example, to the accompanying drawing which shows an elevation view of a partly broken away golf ball manufactured by the process of the present invention in a two-part mold, the lower part of which is partly broken away and the upper part of which is turned through ninety degrees with respect to its position relative to the golf ball in the mold to illustrate the mold cavity.

The golf ball is denoted by reference numeral 10 and is formed throughout from a cured mixture of one hundred parts by weight of a urethane prepolymer and from three to twelve parts by weight of a curing agent. Up to one hundred parts by weight of a plasticizer and up to one hundred parts by weight of a filler and/or colorant along with up to two parts by weight of an ultraviolet light absorber and up to ten parts by weight of an internal lubricant may be added to the curing agent. In addition up to one part by weight of a catalyst may be added to the urethane prepolymer before mixing the prepolymer with the curing agent. Glass or powdered metals, minerals or resins may be present in the mixture to improve the hardness of the final ball.

The mold comprises mold halves 12 and 14, the mold cavities of which are such that the ball, on removal from the mold, has the conventional dimples of a golf ball. The golf ball 10 is manufactured by mixing the urethane prepolymer and the curing agent along with the desired additives after they have been degassed to remove moisture therefrom as by vacuum degassing or the like, filling the mold halves 12 and 14 with the mixed urethane prepolmer and curing agent and curing the mixture at room temperature for approximately three weeks. Alternatively the urethane prepolymer may be preheated to from 200°F. to 220°F. and the curing agent may be heated to from 250°F. to 300°F. before they are mixed together. Optionally curing may be accomplished by heating the mixture for about one hour at 200°F. in the mold and for approximately two hours at 200°F. after being removed from the mold. Two weeks final curing at room temperature may follow the curing out of the mold.

The following Examples illustrate the invention.

EXAMPLE 1

In this Example a golf ball was produced using a mold as shown in the accompanying drawing and a mixture comprising:—

100.0	parts by weight Adiprene L-100	Basic elastomer
0.25	parts by weight adipic acid	Catalyst
9.5	parts by weight CBU	Curing agent
20.0	parts by weight KP-260	Plasticizer
20.0	parts by weight pigment and/or filler	Colorant
0.2	parts by weight Tinuvin P	Ultraviolet light absorber
0.5	parts by weight glycol wax 932	Internal lubricant

The word "Tinuvin" is a Trade Mark.

The Adiprene L-100 is a urethane prepolymer, isocyanate terminated, containing 4.0 to 4.3% isocyanate groups by weight, such as is disclosed in United States Patent No. 3,034,791, and is commercially obtainable from E.I. DuPont De Nemours & Co., Elastomer Chemicals Dept., Wilmington, Delaware. Adiprene L-100 urethane prepolymer is based on poly-(oxytetramethylene) glycols. Adiprene L-420, available from the source as Adiprene L-100, may also be used in the manufacture of the golf ball to produce a golf ball having a greater rebound but providing a lower flexural modulus.

The adipic acid catalyst is added to the urethane prepolymer to promote the reaction of the urethane prepolymer with the curing agent.

The CBU, which is a commercial designation of 3,3¹ Dichlorobenzidine, is commercially available from the Carwin Company, North Haven, Connecticut. The CBU, an organic diamine, is a curing agent capable of reacting with the available isocyanate groups in the urethane prepolymer to form a strong rubbery solid. For easier handling the CBU is dissolved or dispersed in the plastics material.

If desired, MOCA (4,4¹, methylene-bis-(2 chloroaniline)) produced by E.I. DuPont De Nemours & Co., Organic Chemical Department, may be substituted for the CBU as a curing agent if desired. MOCA added to

Adiprene L-420 in less than the standard reaction ratio as indicated in the above quantities produces a golf ball having an acceptable flexural modulus.

The plasticizer KP-260 is 2-ethylhexyl diglycolate commercially obtainable from the Food Machinery & Chemical Corp., Chemicals and Plastic Division, 161 East 42nd Street, New York 17, New York. The KP-260 plasticizer holds the CBU curing agent in solution so that it is easy to work with. The plasticizer improves the resilience of the manufactured golf ball to aid in the bounce thereof and is a relatively inexpensive additive. If desired the KP-260 may be replaced with DOP (di-2-ethylhexylphthalate) obtainable from the same source.

The colorant is not absolutely necessary but is useful to provide golf balls of a desired colour, such as a clean blue-white provided by a titanium dioxide white paste. In this Example the colorant is titanium dioxide white paste No. 22961, commercially obtainable from the Plastics Color Co., Inc., 22 Commerce Street, Chatham, New Jersey.

To prevent degradation and discoloration of the finished golf ball on ageing due to exposure to heat and sunlight, an ultraviolet light absorber is present in the mixture. In this Example the ultraviolet light absorber is Tinuvin P (2(2'-hydroxy 5'-methylphenyl) benzotriazole) which is commercially obtainable from Geigy Industrial Chemicals, Saw Mill River Road, Ardsley, New York.

The internal lubricant is added to produce better mold release and a desired feel for the finished golf ball. In this Example a high molecular weight glycol viz. glycol wax 932 is used. Other high molecular weight glycols such as carbowax 4000 are also suitable.

To obtain the desired cut resistance and increased flexural modulus and hardness, additives, such as aluminum powder or glass beads (denoted by reference numeral 16 in the drawing) may be added to the mixture indicated above. The glass beads may increase the specific gravity of the finished golf ball an undesirable amount. Hollow glass beads may be used to bring the specific gravity of the manufactured golf ball back to the desired specific gravity.

The golf ball may be manufactured by mixing the urethane prepolymer and curing agent at room temperature or at an elevated temperature together with the additives indicated above in the quantities specified. The mixture will have a relatively short pot life of, for example two or three minutes. After a short time the mixture will turn into a gel which is formable and which may be pressed in the mold halves 12 and 14. The time to gel condition can be controlled by the presence and the amount of the catalyst, the ratio of the curing agent to the prepolymer and by the temperature of the reactants. The mixed urethane prepolymer and curing agent together with the additives may then be cured for approximately three weeks at room temperature.

If it is desired to reuse the mold halves 12 and 14 at frequent intervals the urethane prepolymer may be heated to between 200°F. and 220°F. together with the catalyst if one is to be used. The curing agent and the additives, such as the plasticizer, colorant, ultraviolet light absorber and internal lubricant may be heated to between 250°F. and 300°F., after which the urethane prepolymer and curing agent mixtures are mixed together and deposited in the mold. The curing may then be effected for approximately one hour at 200° F. with the golf ball in the mold, and for approximately two hours at 200°F. with the golf ball out of the mold. Subsequently curing may be completed by maintaining the ball at room temperature for approximately fourteen days. If desired, the mixture may be deposited in the mold by vacuum casting, injection transfer or compression molding techniques.

EXAMPLE 2

A mixture comprising 100 parts by wt. Adiprene L-100, 34 parts by wt. diallyl phthalate plasticizer, 4.5 parts by wt. metaphenylene diamine curing agent and 10 parts by wt. of titanium dioxide paste was prepared at 150°F., intrdouced into a mold as shown in the accompanying drawing, and cured in the mold for five minutes at about 150°F. and out of the mold for two weeks at room temperatures. Using such a mixture, the mold can be rapidly re-used.

The golf balls manufactured in accordance with the embodiments above disclosed have superior cut resistance, colour throughout the ball, excellent resilience or rebound and will not age perceptibly due to degradation or discoloration of the composition from which they are constructed. Further the click which is a function of the hardness and flexural modulus of the ball will be substantially the same as golf balls produced by the usual method of wrapping rubber bands about a central core and providing a spherical outer cover therefor.

While a solid golf ball had been specifically disclosed, the process of the present invention may be used to manufacture other types of balls, hollow as well as solid. Hollow balls can be produced in accordance with the present invention by means of a rotational or centrifugal casting technique.

WHAT WE CLAIM IS:—

1. Process for manufacturing a ball which comprises mixing one hundred parts by weight of a urethane prepolymer with

from three to twelve parts by weight of a curing agent for the urethane prepolymer, placing the resultant mixture in an empty mold having a shape corresponding to that of the desired ball and curing the mixture to obtain the required ball.

2. Process according to Claim 1, wherein the mixture includes up to one part by weight of a catalyst to control the reaction of the urethane prepolymer with the curing agent.

3. Process according to Claim 1 or 2, wherein the mixture includes up to one hundred parts by weight of a colorant whereby a ball having a predetermined color is obtained.

4. Process according to Claim 1, 2 or 3, wherein the mixture includes up to two parts by weight of an ultraviolet light absorber.

5. Process according to any one of Claims 1 to 4, wherein up to ten parts by weight of an internal lubricant is included in the mixture.

6. Process according to any one of Claims 1 to 5, wherein up to one hundred parts by weight of a plasticiser is included in the mixture.

7. Process according to Claim 6, wherein up to fifty parts by weight of a plasticiser is included in the mixture.

8. Process according to Claim 6 or 7, wherein the plasticiser is 2-ethylhexyl diglycolate.

9. Process according to any one of the preceding claims, wherein the mixture includes a powdered metal, powdered mineral or powdered resin.

10. Process according to Claim 9, wherein the powdered metal is powdered aluminium.

11. Process according to any one of the preceding claims, wherein the mixture includes glass beads.

12. Process according to Claim 11, wherein the mixture includes hollow glass beads.

13. Process according to any one of the preceding claims which includes the further step of degassing the urethane prepolymer and the curing agent prior to mixing the same together.

14. Process according to any one of the preceding claims, which includes the further steps of heating the urethane prepolymer and heating the curing agent prior to mixing the same together.

15. Process according to any one of the preceding claims wherein the mixture is cured by heating the mixture while in the mold, removing the mixture from the mold and completing the curing by heating the mixture while out of the mold.

16. Process according to any one of claims 1 to 13 wherein the curing is effected at room temperature.

17. Process according to any one of the preceding claims, wherein the urethane prepolymer is isocyanate terminated and contains from 4.0 to 4.3% isocyanate groups by weight.

18. Process according to any one of the preceding Claims, wherein the curing agent is 3,3¹-dichlorobenzidine.

19. Process according to any one of Claims 1 to 17, wherein the curing agent is (4,4¹ methylene-bis-(2 chloroaniline).

20. Process according to any one of the preceding claims, wherein the mold is such that a golf ball is produced.

21. Process according to Claim 1, substantially as described in either of the foregoing Examples.

22. A ball, whenever produced by the process claimed in any one of the preceding claims.

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1 SHEET *This drawing is a reproduction of the Original on a reduced scale*